Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA)

The 2018 Evaluation Report to the U.S. Congress on the Effectiveness of Coastal Wetlands Planning, Protection and Restoration Act Projects

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2018.

The 2018 Evaluation Report to the U.S. Congress on the Effectiveness of Coastal Wetlands, Planning, Protection and Restoration Act Projects.

Map images provided by the U.S. Geological Survey Wetland and Aquatic Research Center.

Cover image: U.S. EPA

CWPPRA Mission Statement

Louisiana continues to face an unprecedented collapse of its entire coastal ecosystem and the vital economic activity and unique culture that it supports. Over the past 28 years, the Louisiana Coastal Wetlands Conservation and Restoration Task Force (Task Force) has fulfilled its role under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) by implementing a science- and engineering-based program that extensively engages stakeholders and the public and serves as the Nation's model for effective and efficient coastal restoration. In order to secure the future of Louisiana's coast, the Task Force and stakeholders must share a common vision, one that aligns with State and national priorities.

Documentation

This report is submitted by the Task Force in accordance with CWPPRA, Title III of Public Law 101–646. This report fulfills the CWPPRA mandate, which requires a report to the U.S. Congress every 3 years on the effectiveness of Louisiana's coastal wetland restoration projects.

Acknowledgements

The Louisiana CWPPRA Task Force wishes to thank Governor of Louisiana John Bel Edwards, the Louisiana Legislature, the Federal Louisiana Delegation, and the U.S. Congress for their support of this crucial program.

EPA

The Des Allemands project is the first swamp restoration constructed under CWPPRA. By improving the hydrology and reconnecting the degraded swamp to the bayou, swamp vegetation is recovering.

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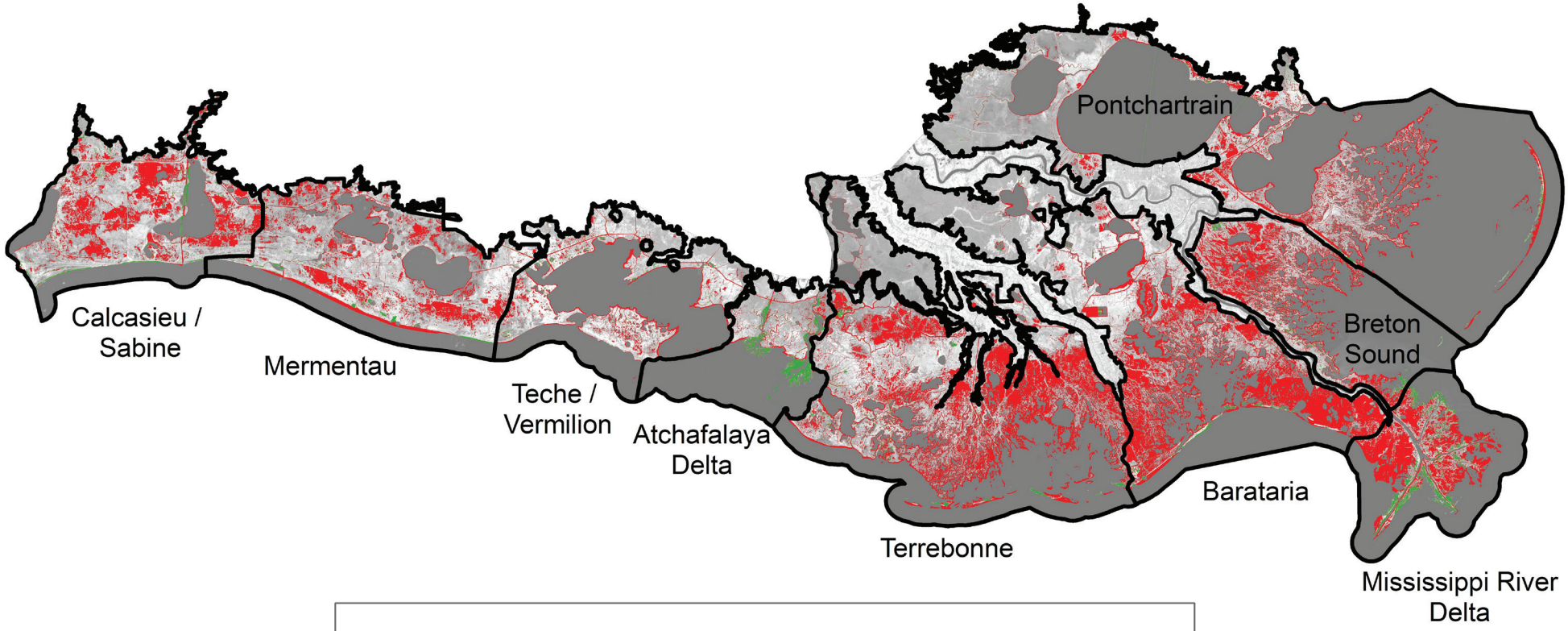
Coastal Louisiana Land Loss



Couvillion et al. 2017

Introduction

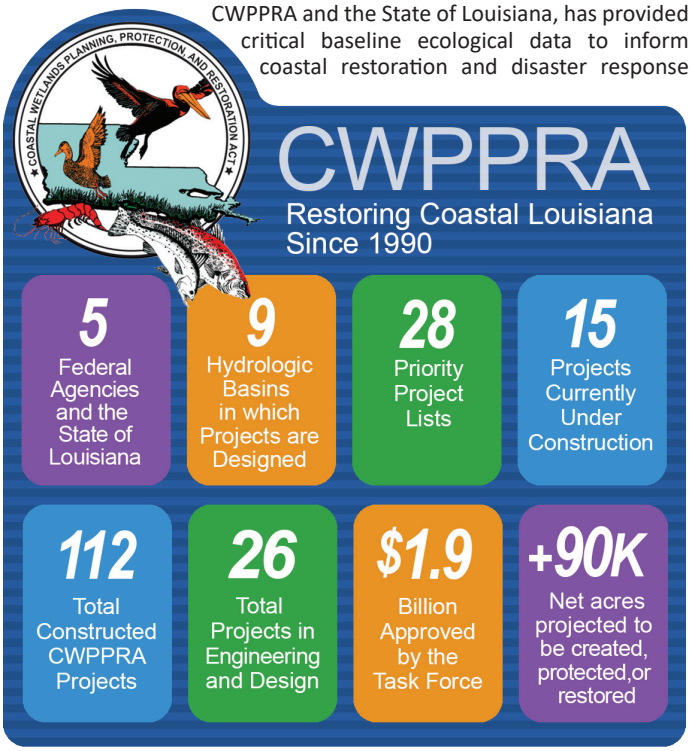
Louisiana's coastal zone is home to approximately 37 percent of all coastal marshes and 45 percent of all intertidal coastal marshes in the lower 48 States, but annually, Louisiana is losing 80 percent of the entire nation's coastal wetlands. Since the 1930s, coastal Louisiana has lost more than 1860 square miles (1.2 million acres), an area more than 25 times larger than Washington, D.C (Couvillion et al, 2017).

The dire need to restore and protect Louisiana's coastal wetlands has been clearly established and our ability to sustain the ecological and economic health of the Louisiana coastal zone is largely dependent upon coastal restoration and protection activities. Louisiana's wetlands provide a variety of benefits that serve the Nation across an array of economic sectors. Because of these benefits, the coastal wetland loss crisis in Louisiana is considered a matter of national concern.

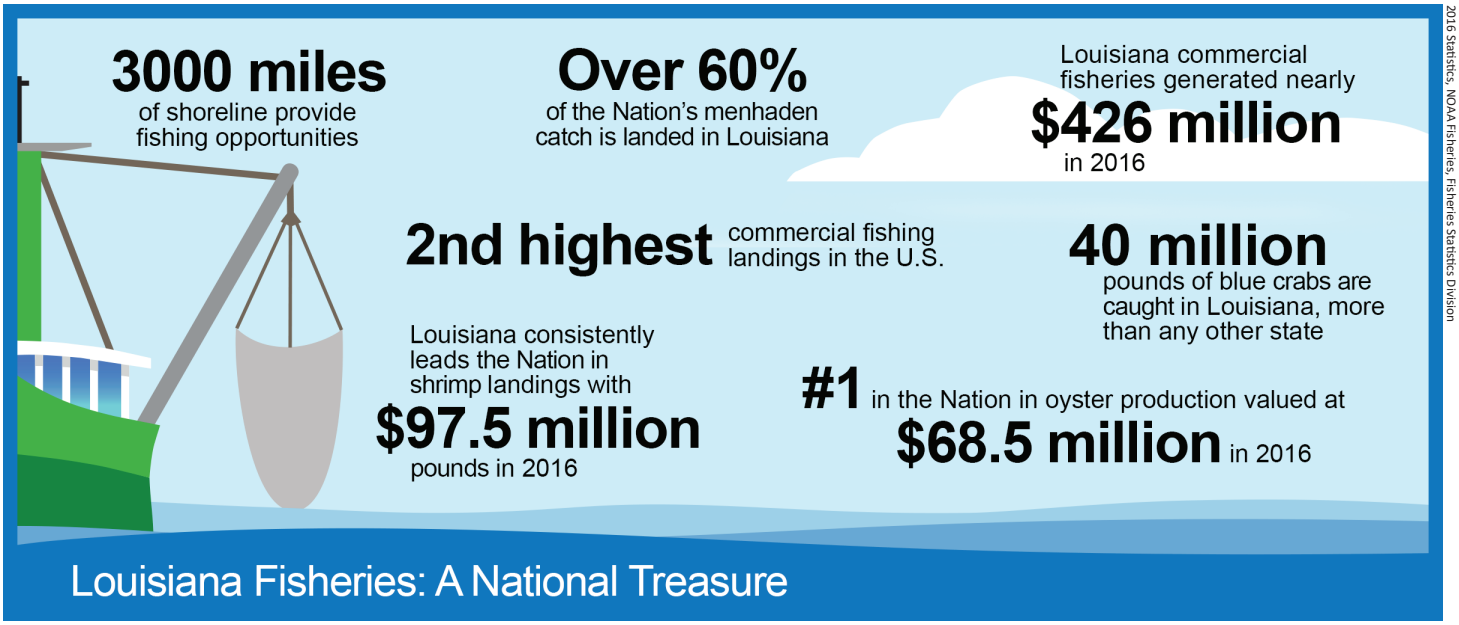
Congress recognized the ongoing severe coastal wetland losses in Louisiana and the increasing impacts on locally, regionally, and nationally important resources when it established the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) in 1990 (Public Law 101-646, Title III). As part of CWPPRA, Congress established and directed the Louisiana Coastal Wetland Conservation and Restoration Task Force (Task Force) to prepare, annually update, and implement a list of Louisiana coastal wetland restoration projects. Consistent with Louisiana's Comprehensive Coastal Master Plan, which charts Louisiana's coastal restoration for the next 50 years, these projects provide for the long-term conservation of wetlands and dependent fish and wildlife populations.

Between 1990 and 2018, CWPPRA has constructed, or funded for construction, projects to protect and restore more than 90,000 net acres (140 square miles) of Louisiana's coastal wetlands. As of October 2018, 112 projects have been constructed, 15 are currently under construction, and 26 are in engineering and design. Between 2016 and 2018, the CWPPRA Task Force approved 13 new projects for Phase 1 - Engineering and Design. During that same period, the Task Force authorized 7 projects for Phase 2-Construction, which are expected to result in 1,737 net acres of wetlands. Several projects have also completed construction during that time frame, restoring and creating a total of 2,130 net acres of wetlands (Table 1, page 4). CWPPRA projects are typically planned and designed for a 20-year lifespan following construction completion. During that timeframe, the project will be operated and maintained to ensure effectiveness and overall success, and will be monitored for environmental parameters such as land change and emergent vegetation and inform future operation and maintenance activities.

CWPPRA monitoring data provide vital information to evaluate not only the CWPPRA projects but also other restoration programs and the state of the coast in general. The monitoring data collected through the CWPPRA program are used to select, prioritize, and design nearly all coastal restoration projects. Since 2007, the Coastwide Reference Monitoring System (CRMS), primarily funded by CWPPRA and the State of Louisiana, has provided critical baseline ecological data to inform coastal restoration and disaster response



activities throughout Louisiana's four ecological regions. These regions cover nine hydrologic basins: Calcasieu-Sabine, Mermentau, Teche-Vermilion, Atchafalaya, Terrebonne, Barataria, Mississippi River Delta, Breton Sound, and Pontchartrain. The following sections provide net acres benefitted* and an example of a constructed project in each of these basins, demonstrating the effectiveness of CWPPRA to address land loss in Louisiana's coastal wetlands.



*It is important to distinguish between WVA acres of benefit, which can include multiple types of benefit, and reported land area benefit acreages. The land change dynamics acreage numbers for each basin in this report are derived from a comparison between pre-construction and post-construction land change rates assessed via satellite imagery.

Table 1. Total net acres projected to be created, protected or restored for projects in Engineering and Design, Construction, and projects constructed from 2016 to 2018. Total net acres for Engineering and Design: 4305 acres; Construction: 1737 acres; Constructed: 2130 acres (CWPPRA Environmental Work Group, 2018)

Project Name	Project Number	PPL	Date Authorized	Total net acres
Fritchie Marsh Creation and Terracing	PO-173	25	21-Jan-16	290
Caminada Headlands Back Barrier Marsh Creation #2	BA-193	25	21-Jan-16	207
East Leeville Marsh Creation and Nourishment	BA-194	25	21-Jan-16	322
Barataria Bay Rim Marsh Creation and Nourishment	BA-195	25	21-Jan-16	251
Oyster Lake Marsh Creation and Nourishment	CS-79	25	21-Jan-16	438
Bayou LaLoutre Ridge Restoration and Marsh Creation	PO-178	26	12-Jan-17	187
St. Catherine Island Marsh Creation & Shoreline Protection	PO-179	26	12-Jan-17	214
Bayou Decade Ridge and Marsh Creation	TE-138	26	12-Jan-17	378
Salvinia Weevil Propagation Facility	LA-284	26	12-Jan-17	26
Sabine Marsh Creation Cycles 6&7	CS-81	27	09-Feb-18	900
Bayou Cane Marsh Creation	PO-81	27	09-Feb-18	356
Northeast Turtle Bay Marsh Creation & Critical Areas Shoreline Protection	BA-206	27	09-Feb-18	372
Mid-Breton Land Bridge Marsh Creation & Terracing	BS-32	27	09-Feb-18	364
Hydrologic Restoration & Planting Des Allemands Swamp	BA-34-2	10	22-Jan-16	NA
Cole's Bayou Marsh Restoration	TV-63	21	22-Jan-16	340
Rockefeller Gulf Shoreline Stabilization	ME-18	10	22-Jan-16	256
Northwest Turtle Bay Marsh Creation	BA-125	21	12-Jan-17	432
Cameron Meadows Marsh Creation and Terracing	CS-66	22	12-Jan-17	326
Cameron-Creole Freshwater Introduction CU2	CS-49	18	09-Feb-18	218
Caminada Headland Back Barrier Marsh Restoration	BA-171	23	09-Feb-18	165
Barataria Landbridge Shoreline Protection Phase 3, CU 7&8	BA-27	9	16-Jan-02	264
Bayou Dupont Sediment Delivery - Marsh Creation #3 and Terracing	BA-164	22	14-May-15	118
Bayou Bonfouca Marsh Creation	PO-104	20	24-Jan-13	1,748
				TOTAL: 8,172

Projects authorized for Phase 1 Engineering and Design

Projects authorized for Phase 2 Construction from 2016-2018

Projects constructed from 2016-2018

The CWPPRA Environmental Work Group uses Wetland Value Assessments to analyze and determine potential benefit acres for a CWPPRA project over the length of its 20-year lifespan.

CALCASIEU-SABINE BASIN

Land Change Dynamics

The Calcasieu-Sabine Basin is located in the southwest Louisiana coastal zone, from Texas eastward to Grand Lake. It contains vast expanses of coastal marshes spanning from saline to freshwater environments. Major waterbodies include Calcasieu and Sabine Lakes, Calcasieu Ship Channel, and the Gulf Intracoastal Waterway (GIWW).

The Calcasieu-Sabine Basin experienced the highest rates of wetland loss prior to the 1970s (average -2,348 acres/yr, -9.5 km^2/yr); however, rates have slowly decreased since that time, except for hurricane-induced losses in 2005 and 2008. Rates of wetland loss have ranged from a net loss of 2,470 acres/yr (~10 km^2/yr) at the peak of wetland loss rates, to an estimate of 494 acres/yr (~2 km^2/yr) most recently (Couvillion et al. 2017). The major causes of land loss in this basin are saltwater intrusion, subsidence, and storms.

In the Calcasieu-Sabine Basin, constructed marsh creation and shoreline protection features, similar to the project highlighted below, have contributed approximately 3,700 acres (15.2 km^2) of net land area benefit, either from new land built or land sustained from project inception through 2018.

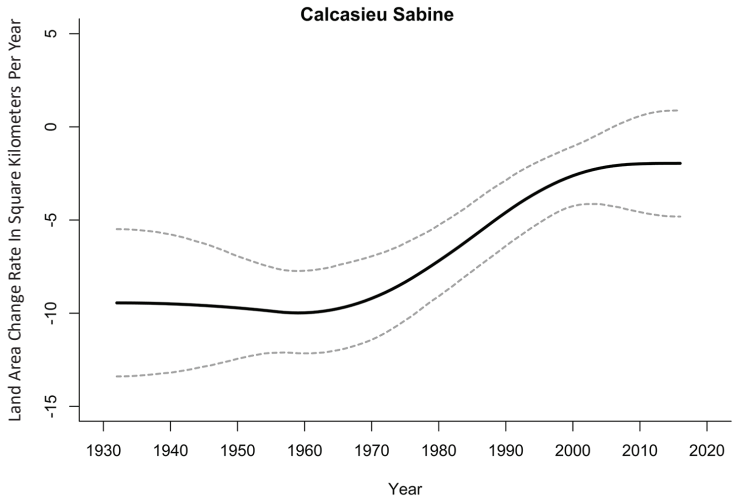


Fig. A. Land area change rate vs. time in Calcasieu Sabine Basin. See Appendix 3.

$114.5 Million Expended

20 Projects Constructed

3 Projects in Engineering & Design

4 Projects in Construction

Figures current as of 2018

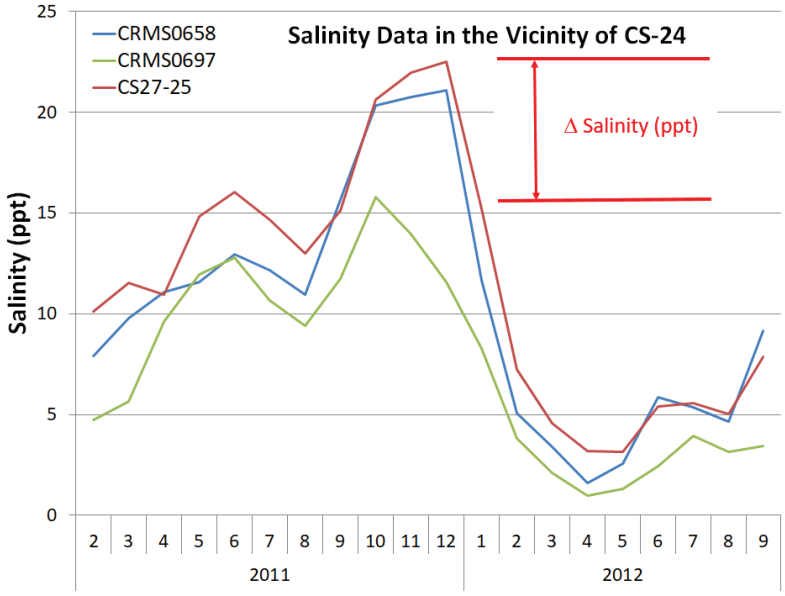


Fig. B: Salinity at project site CRMS0697 and two reference stations.

Perry Ridge Shore Protection (CS-24) Project

Constructed: February 1999

The CS-24 project extends along the north bank of the Gulf Intracoastal Waterway (GIWW) from Perry Ridge to the Vinton Drainage Canal. Marsh loss near Perry Ridge has been caused by water level fluctuations and tidal scour resulting from water exchange through breaches in the northern spoil bank of the GIWW. Approximately 23,300 linear ft of rock dike was constructed as a shoreline protection feature to protect the existing emergent wetlands and prevent further deterioration from shoreline erosion and tidal scour. In addition to benefits of shoreline protection, a secondary objective was to reduce the occurrence of salinity spikes within the project area.

Pre- and post-construction land/water analysis showed a 5% (i.e., 306.5 acre) increase in land area after project implementation and is directly attributable to the project features reversing shoreline erosion and reducing the tidal export of material from the interior wetlands. The post construction land to water ratio indicates expansion of the interior marsh behind the protected shoreline.

Overall from 1999-2016, the project shoreline has gained 2 ft/yr while the reference area has lost 2 ft/year (Mouledous et al. 2017). CRMS salinity data indicate that project features effectively reduced high salinity waters from entering the project area. In recent droughts, average monthly salinity at CRMS0697 was 5 parts per thousand (ppt) less than at stations outside of the project boundary south of the GIWW.

MERMENTAU BASIN

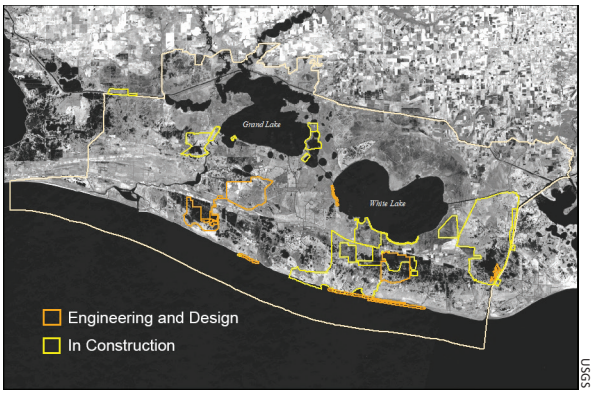


Fig. C. CWPPRA Projects in the Mermentau Basin. See Appendix 4.

Land Change Dynamics

The Mermentau Basin is located in the eastern portion of the Chenier Plain in Cameron and Vermilion Parishes. The Mermentau Basin can be divided into two sub-basins. The Lakes sub-basin is delineated by the Gulf Intracoastal Waterway to the north and Louisiana Highway 82 to the south. Highway 82 runs atop and between the Grand Chenier-Pecan Island ridge complex. The Chenier sub-basin lies between this ridge complex and the Gulf of Mexico. About 18 percent (128,200 acres) of the basin lands are publicly owned as Federal and State refuges and State wildlife management areas (Mouledous and Sharp 2016).

In terms of total area, the Mermentau Basin experienced approximately 120,000 acres of wetland loss from 1932 to 2016 and a change rate averaging -1,470 acres/year (Couvillion et al. 2017). The two sub-basins suffer from distinctly different hydrologic problems. The most critical wetland problem in the Lakes sub-basin is excessive flooding due to numerous blockages of drainage outlets that increase water levels and prolonged flooding. The higher water levels may also be responsible for shoreline erosion in this area (Mouledous and Sharp 2016). The same blockages to the north also reduce freshwater inputs into the Chenier sub-basin in the south, facilitating saltwater intrusion.

Shoreline protection features, like those in the project highlighted below, have effectively reduced or halted shoreline erosion in their project locations. Shoreline protection and terracing projects in Mermentau Basin have contributed to approximately 985 acres (4.0 km^2) of net land area benefit via new land restored or land sustained from project inception through 2018.

$67.9 Million Expended	10 Projects Constructed
1 Project in Construction	2 Projects in Engineering & Design

Figures current as of 2018

South White Lake Shoreline Protection (ME-22)

Constructed: August 2006


USACE

Figure D. Photograph of a section of ME-22 taken in 2016

The ME-22 project is located along the southern shoreline of White Lake from Will's Point to the western shore of Bear Lake in Vermilion Parish, Louisiana. The south shoreline of White Lake has been retreating at an estimated average rate of 15 feet per year as a result of wind-induced wave energy. If the shoreline would have continued eroding in the project area, low marsh management levees likely would have been breached, which would have increased interior marsh loss rates in the project area.

Approximately 61,500 linear feet of segmented breakwaters, using an estimated 270,000 tons of stone, were constructed to protect 687 acres of shoreline and interior marsh. The foreshore dike includes gaps every 1,000 feet, as well as gaps at pipeline crossings and navigation crossings. Additionally, material dredged to create a flotation channel was placed beneficially behind the breakwaters to create approximately 172 acres of marsh substrate.

The South White Lake Shoreline Protection project is in very good condition overall and functioning as designed. Aerial imagery suggests that the shoreline erosion rate of the project area has dramatically decreased, and is showing many indications of progradation and emergent marsh forming behind the constructed rock dike segments. Some low areas in the dike were noticed during previous inspections from initial settling during construction but has since stabilized, and is fully functional in these areas.

TECHE-VERMILION BASIN

Land Change Dynamics

The Teche-Vermilion Basin, located in the central Louisiana coast, contains roughly 300,000 acres (1,214.1 km^2) of wetlands. Much of the basin is occupied by three large bays: East Cote Blanche Bay, West Cote Blanche Bay, and Vermilion Bay. Marsh Island is an important hydrologic feature because it separates these bays from saltier Gulf of Mexico water. Therefore, marshes in this basin are primarily fresh, intermediate, and brackish with relatively few salt marshes.

The Teche-Vermilion Basin experienced one of the smaller net wetland area losses of the nine coastal basins with approximately 36,800 acres (149.0 km^2) lost between 1932 and 2016 (Couvillion et al. 2017). Factors affecting wetland change in this basin include shoreline erosion, change in hydrologic conditions, storm impacts, and herbivory. Teche-Vermilion Basin follows a similar pattern to that of the coastwide trend of loss rates increasing to a peak in the late 1970s, followed by a reduction in loss rates since that time. The latest analyses indicate the wetland area change rate in Teche/Vermilion has been positive in recent years.

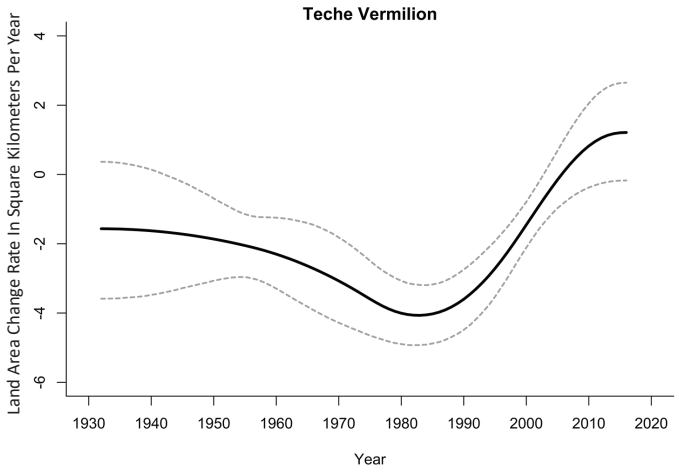


Fig. E. Land Area Change Rate vs. Time in Teche-Vermilion Basin. See Appendix 4.

Terracing, hydrologic restoration, marsh creation, and shoreline protection projects have had positive impacts on the landscape of the Teche-Vermillion Basin. Excluding hydrologic restorations, CWPPRA projects in this basin have collectively contributed approximately 300 acres (1.2 km^2) of net land area benefit via new land built or land sustained from project inception through 2018.

$48.8 Million Expended

11 Projects Constructed

1 Project in Construction

Figures current as of 2018

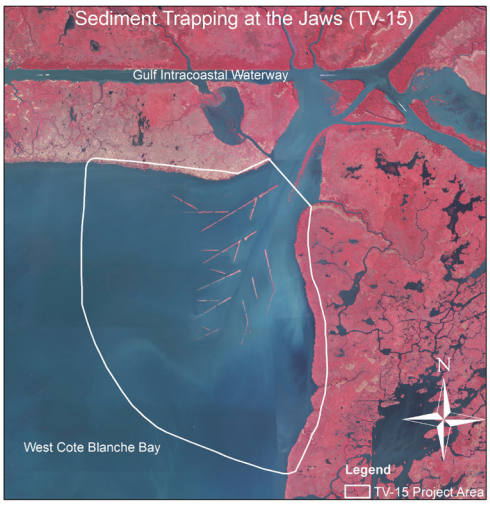


Fig. F. 2005 post construction site.

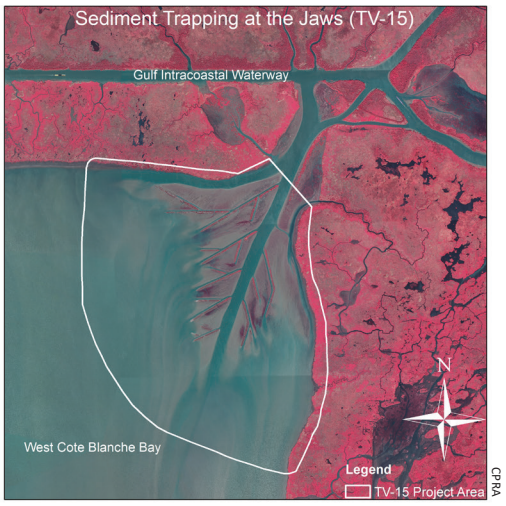


Fig. G. 2008 post construction site.

Sediment Trapping at "The Jaws" (TV-15)

Constructed: December 2004

The TV-15 project is located in the northeastern corner of West Cote Blanche Bay in St. Mary Parish near the intersection of the Charenton Drainage Canal and Gulf Intracoastal Waterway (GIWW). Continuous wind and wave energy in the Bay prevents sediments from the GIWW from settling to build marsh. Shoreline erosion rates near the project site are 15 ft/yr. The project features include 40,100 linear feet of earthen terraces, conveyance channels, and vegetative plantings. The terraces reduce wind-blown waves (fetch), currents, and turbidity while inducing sediment deposition.

In order to minimize erosive energies, the terrace slopes were planted with approximately 38,500 California bulrush and giant cutgrass plants. The plantings were designed to reduce shoreline erosion, further enhance sediment deposition, and stabilize newly placed sediment. This resulted in the creation of mud flats and submerged aquatic vegetation (SAV) beds in formerly open water areas. By the 2018 annual inspection, the plant community was well established, expanding to fill some of the space between terraces.

Pre- and post-construction land/water analysis shows an 800 acre (20% increase) in mud flats and SAV beds between the terraces (Aucoin et al. 2012). Overall, the project has created an effective sediment trap and shoreline erosion protection complex and is expected to maintain this function throughout the project life.

ATCHAFALAYA BASIN

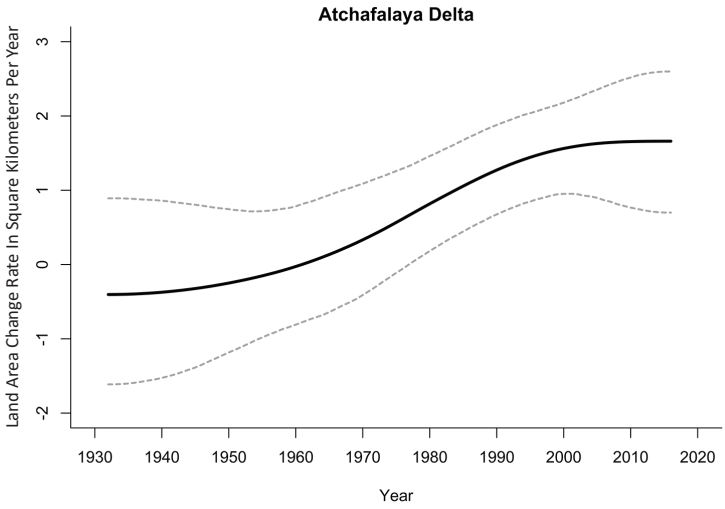


Fig. H. Land Area Change Rate vs. Time In Atchafalaya Basin. See Appendix 4.

Land Change Dynamics

The Atchafalaya Basin is located in the central part of the coastal zone, west of the Terrebonne Basin. Major water features in the basin include the Lower Atchafalaya River, Wax Lake Outlet, and Atchafalaya Bay. Previous Mississippi River delta complexes formed the majority of the land within the Atchafalaya Basin. Subaerial delta growth in Atchafalaya Bay began in the early 1970s.

The Atchafalaya Basin is unique among the coastal basins because it has a growing delta system with nearly stable wetlands. Wetland loss is minor in the areas north of Atchafalaya Bay when compared to the other basins. According to Couvillion et al. (2017), the basin experienced more than 4,000 acres (16.2 km^2) net wetland gain since 1932. Annual land change rates early in the study period showed a negative trajectory. However, following the opening of the Wax Lake Outlet in 1942, sediment deposition increased, and a subaerial active delta emerged after the flood of 1973. These factors positively influenced the Atchafalaya Basin's land change rates.

The two CWPPRA projects in this basin (AT-02 and AT-03) have contributed approximately 1,375 acres (5.6 km^2) of wetlands to the area collectively via new land built or land sustained from project inception through 2018.

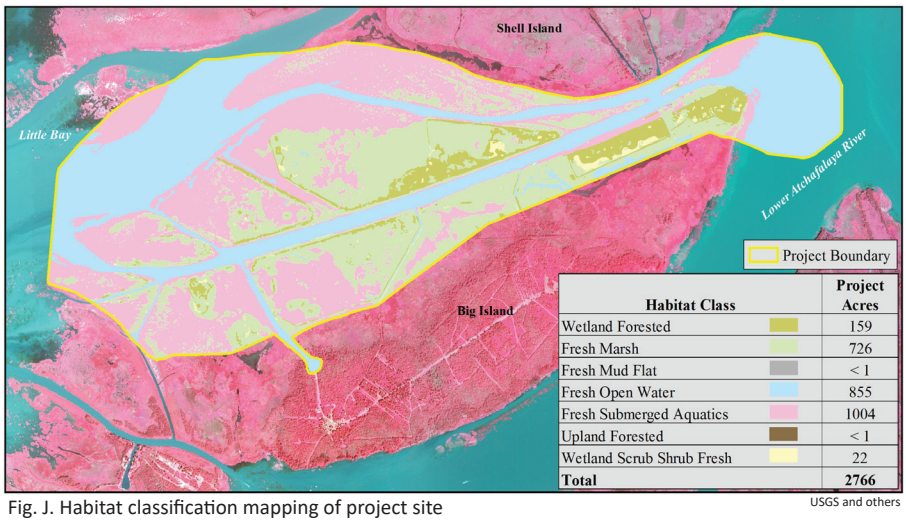
$10.8 Million Expended **2 Projects Constructed**

Figures current as of 2018

The Big Island Mining (AT-03)

Constructed: October 1998

Big Island, located within the Louisiana Department of Wildlife and Fisheries administered Atchafalaya Delta Wildlife Management Area, was constructed during a period from 1974-1987 as a dredged material island with the expansion of the Lower Atchafalaya River Bay and Bar navigation channel. The island extends for 2 miles along the western delta, the largest dredged material spoil area constructed in the Atchafalaya Delta. The creation of Big Island impedes fluvial discharge to the western Atchafalaya Delta due to its size, elevation, and location.



Habitat Class	Project Acres
Wetland Forested	159
Fresh Marsh	726
Fresh Mud Flat	< 1
Fresh Open Water	855
Fresh Submerged Aquatics	1004
Upland Forested	< 1
Wetland Scrub Shrub Fresh	22
Total	**2766**

Fig. J. Habitat classification mapping of project site

USGS and others

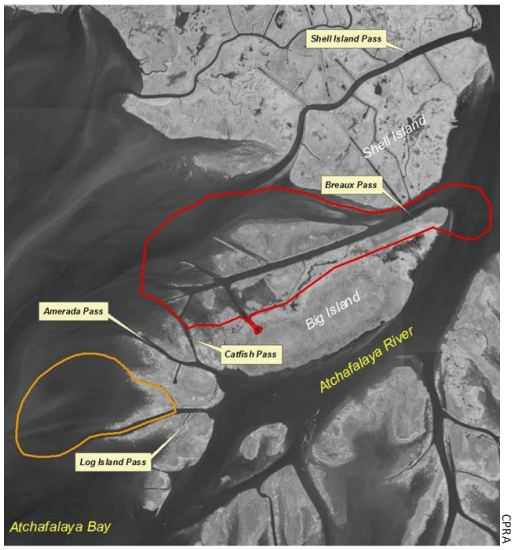


Fig. I. 2009 project site after construction.

In order to improve sediment delivery, channels mimicking the natural features of delta lobes were constructed at depths of 10 feet. Material from the channel construction was placed into five disposal areas creating mud flats, submerged aquatic vegetation (SAV) beds, and fresh marsh in formerly open water areas.

The Big Island Mining (AT-03) project enhanced sediment transport and Delta growth in the northwestern Atchafalaya Delta by construction of a distributary network of channels and dredged material islands. Big Island Mining was successful in creating 703 acres of emergent marsh as of Fall 2016 and increasing the rate of wetlands growth in the project area during the 18-year post-construction period (Fig J). The wetland growth rate from 1998-2016 were calculated at 13 acres/year, exceeding the pre-construction growth rates estimates of 3-4 acres/year from 1956-1978 (Curole et al. 2018).

TERREBONNE BASIN

Land Change Dynamics

The Terrebonne Basin is an abandoned delta complex, consisting of marshes and a network of old distributary ridges extending southward from Houma. It is characterized by a thick section of unconsolidated sediments that are undergoing dewatering and compaction, contributing to high subsidence. The southern end of the basin is defined by a series of narrow, low-lying barrier islands. The Terrebonne Basin supports about 155,000 acres (627.3 km^2) of swamp and almost 574,000 acres (2,322.9 km^2) of marsh.

The Terrebonne Basin has experienced the greatest decrease in wetland area with approximately 321,730 acres (1,302.0 km^2) of net loss since 1932 (Couvillion et al. 2017). The basin experienced higher annual change rates in the late 1970s-early 1980s similar to coastwide trends, with gradually decreasing loss rates since that time. Land loss in the Terrebonne Basin is attributed to subsidence, sediment deficit, saltwater intrusion along navigation canals, historic oil and gas activity, habitat switching due to prolong high water levels (swamp/fresh marshes) and natural deterioration of barrier islands.

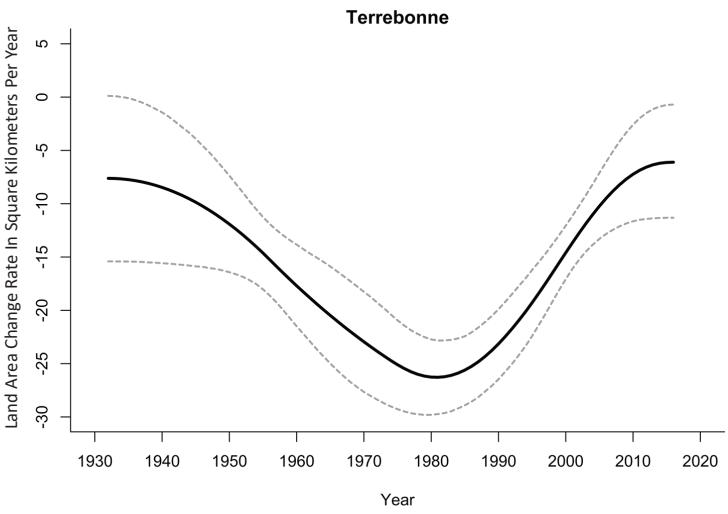


Fig. K. Land Area Change Rate vs. Time in Terrebonne Basin. See Appendix 4.

Restoration activities in the Terrebonne Basin include marsh creation, shoreline protection, hydrologic restoration and barrier island restoration. Excluding hydrologic restoration, CWPPRA projects in the Terrebonne Basin have collectively contributed approximately 2,500 acres (10.1 km^2) of net land area benefit via new land built or land sustained from project inception through 2018.

$264.7 Million Expended

24 Projects Constructed

4 Projects in Engineering & Design

1 Project in Construction

Figures current as of 2018

Fig. L. (top to bottom) post constuction, post hurricanes Katrina and Rita, current.

Timbalier Island Dune and Marsh Creation (TE-40)

Constructed: December 2004

The TE-40 project used sediment from the Gulf of Mexico to restore 2.2 miles of the beach rim and dune system and create a marsh platform on the bay side of the Timbalier Island. Approximately 4.6 million cubic yards of material was dredged from the Little Pass, and over 110,000 container grown plants consisting of eight species were initially planted. This project was constructed in summer 2005 prior to the devastating impacts of Hurricanes Katrina and Rita. While the impacts to Timbalier Island appeared to be initially significant, the photograph taken 14 months after the hurricanes shows the resilience of the project after tidal forces reworked the sediment.

The western shorelines of Timbalier Island maintained their position during this intense period of hurricane activity while the eastern shorelines transgressed. Therefore, a considerable volume of sediment from the TE-40 restoration area was retained in the Timbalier Island sediment budget since the western portion of the island seems to have been nourished in the post-construction period. Elevation and subaerial habitats are declining in the TE-40 restoration area principally due to the magnitude and frequency of tropical storm activity in the vicinity of the project (CPRA, TE-40 2011 Inspection Report).

BARATARIA BASIN

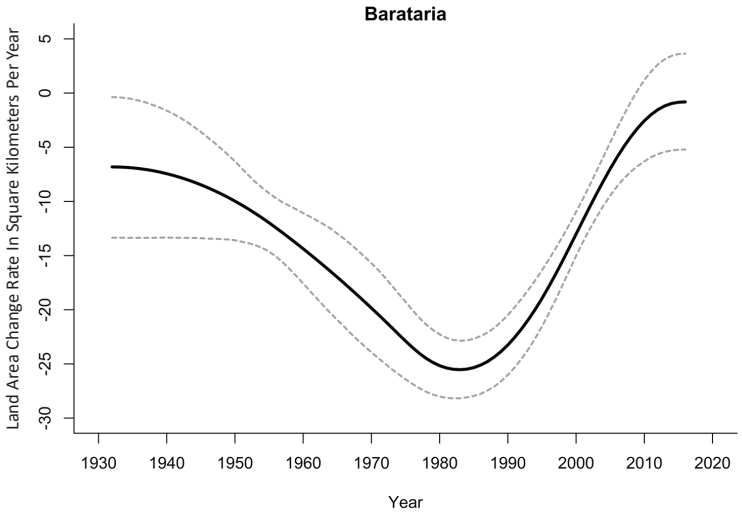


Fig. M. Land Area Change Rate vs. Time In Barataria Basin. See Appendix 4.

Land Change Dynamics

The Barataria Basin is located south-southwest of New Orleans. It contains vast expanses of forested and herbaceous wetlands spanning from saline to freshwater environments.

The Barataria Basin has experienced the second greatest land loss of the nine coastal Louisiana basins, with a net loss of approximately 277,000 acres (1,121.0 km^2) of wetlands since 1932. Rates of wetland loss have ranged from a net loss of approximately 6,178 acres/year (25.0 km^2/year) at the peak of wetland loss rates, to a loss of 210 acres/year (0.8 km^2/year) most recently (Couvillion et al. 2017). Wetland loss within the Basin is attributed to a combination of natural and anthropogenically-influenced factors including sea level rise (SLR), subsidence, shoreline erosion, herbivory, and human development such as channelization and levee construction.

Excluding hydrologic restoration, CWPPRA projects have collectively contributed to approximately 5,600 acres (22.7 km^2) of net land area benefit via new land built or land sustained from project inception through 2018.

$427.4 Million Expended

21 Projects Constructed

6 Projects in Engineering & Design

4 Projects in Construction

Figures current as of 2018

Mississippi River Sediment Delivery System Bayou Dupont (BA-39) Project

Constructed: May 2010

The BA-39 project was the first CWPPRA project to use pipeline transport of sediment from the river to build marsh. The project involved dredging sediment from the Mississippi River for marsh creation and then pumping it via pipeline into an area of open water and broken marsh in a rapidly eroding and subsiding section of the Barataria landbridge. The BA-39 project includes approximately 568 acres of marsh fill hydraulically dredged and transported 5 miles from the Mississippi River and 32,176 linear feet (6.1 miles) of containment dikes.

A recent inspection revealed that the containment dikes and marsh creation areas are performing as designed. The inspected project areas were all heavily vegetated and the gaps along the project perimeter appear to be allowing tidal exchange in their immediate areas. The predicted elevation for the project area by year 5 (2014) was +1.4 feet, but the majority of the project area (≥ 84.3%) was surveyed at a higher elevation, with the highest percentage of acres (53.9%) between +1.5 feet and +2.0 feet. Higher elevation can be expected due to the higher initial fill and significant sediment deposition from Hurricane Isaac (CPRA, BA-39 2016 Inspection Report).

Since the construction of BA-39, three additional marsh creation projects that used river sediment have been completed within four miles of the project area including: the Bayou Dupont Marsh and Ridge Creation project (BA-48) (2015), the Long-Distance Sediment Pipeline (BA-43-EB) (2015) project, and, the Bayou Dupont Sediment Delivery Marsh Creation #3 (BA-164) (2017) project.

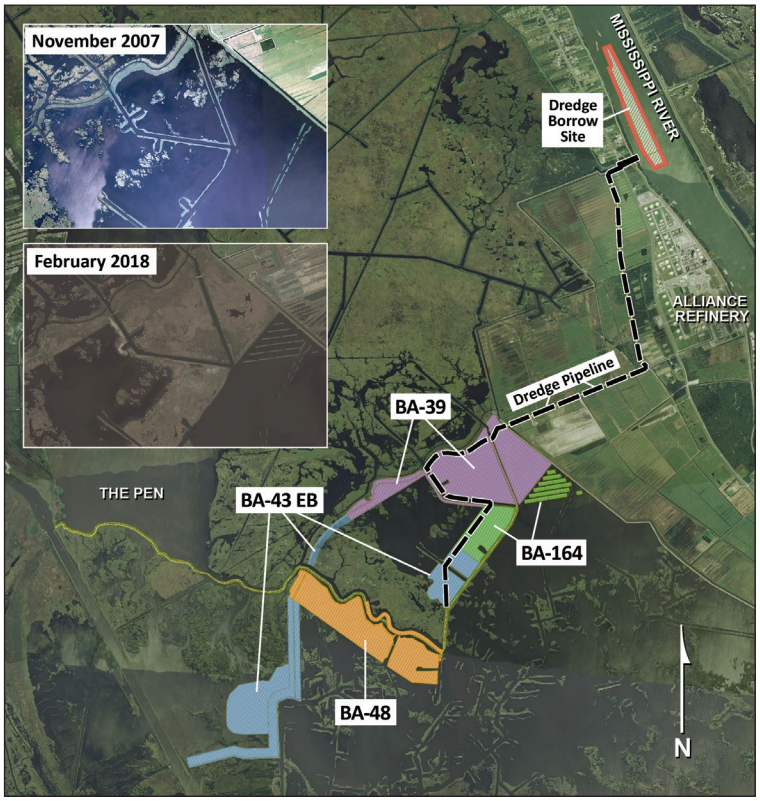


Fig. N. BA-39 Project Area.

MISSISSIPPI RIVER DELTA

Land Change Dynamics

The Mississippi River Delta Basin is located in the southeast of Louisiana's coastal zone on the edge of the Gulf of Mexico's continental shelf. Its bird's foot configuration is characteristic of alluvial deposition in deep water. In this configuration, large volumes of sediment are required to create land area; consequently, land is being lost in this delta more rapidly than it is being created. However, the basin contains expanses of fresh and intermediate marshes. Major waterbodies include the mainstem Mississippi River, South Pass, and Pass-a-Loutre, all of which are directly connected to the Gulf of Mexico.

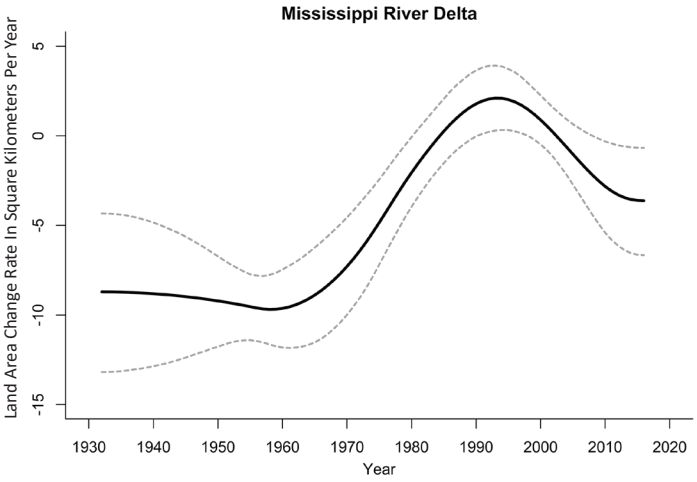


Fig. O. Land Area Change Rate vs. Time In The Mississippi River Delta. See Appendix 4.

Similar to other hydrologic basins, the Mississippi River Basin has experienced a net decrease in wetland area from 1932 to 2016. The total wetland area of the basin has decreased by 92,665 acres (375.0 km^2). As a percentage of the 1932 area, the basin has experienced the greatest percentage decrease in wetland area of approximately -55 percent of total area (Couvillion et al. 2017). The Mississippi River Delta Basin has experienced a reduction in wetland loss rate since the 1960s, reaching a point of wetland gain for portions of the 1990s, only to be followed by a negative trend due to the effects of Hurricane Katrina in 2005 (Barras, 2006). The major causes of land loss in this basin are subsidence and compaction. Unlike other areas of coastal Louisiana, the Mississippi River Delta has a relative abundance of inflowing fresh water and sediments. Despite the availability of these resources, the overall growth of emergent delta has been truncated. In the present position, the Mississippi River deposits sediments into much deeper water than has been the case historically. These unconsolidated sediments are highly susceptible to compaction, reducing the life span of emergent wetlands.

This basin contains three hydrologic restoration/sediment diversion projects, the effects of which are difficult to determine, particularly because of the negative effects of Hurricane Katrina. Excluding hurricane effects, restoration projects in the Mississippi River Delta Basin are thought to have contributed to an estimate of approximately 1,300 acres (5.3 km^2) of net land area benefitted collectively via new land built or land sustained from project inception through 2018.

$264.7 Million Expended **4 Projects Constructed**

Figures current as of 2018

USACE

Fig. P. West Bay Diversion 2016.

West Bay Sediment Diversion (MR-03)

Constructed: November 2003

The MR-03 project was the first major diversion project constructed off the Mississippi River in Louisiana. The project features a crevasse on the right descending bank of the main Mississippi River channel, at mile 4.7 above Head of Passes (AHP), a conveyance channel, and a number of beneficial-use areas for dredge material from Pilottown Anchorage and USACE maintenance dredging operations. The project outfall area is a large, shallow, open-ended receiving basin. The uncontrolled diversion, with a designed capacity of 50,000 cubic feet per second (cfs), was constructed in November 2003 to promote the creation of a subdelta and formation of emergent marsh by redirecting and capturing sediments from the river.

While the land/water analysis does not reflect significant land gain via the crevasse or other natural processes as of the latest photography, the strategic placement of material throughout the basin aids in the retention of sediments delivered through the crevasse, and increases in the land/water ratio are expected in the future. Volumetric analyses derived from surveys and elevation data indicate a current sedimentation rate of more than 3 million cubic yards per year (2011-2015), and a considerable decrease in overall depth of the project area (USACE Spatial Analysis 2016). The increased sedimentation rates, paired with continued sediment retention via material from beneficial use events, suggests future potential for sub-aerial land gain. It is also expected that years of higher river/increased flow will continue to have a positive impact on the rate of deposition in the receiving basin.

BRETON SOUND BASIN

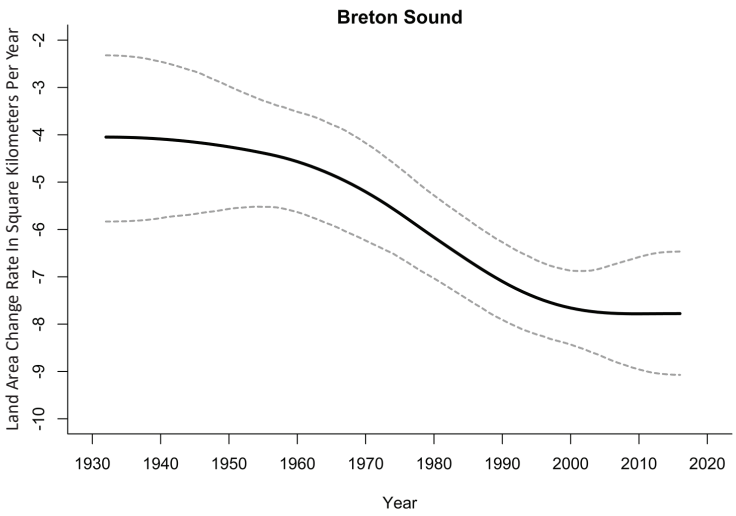


Fig. Q. Land Area Change Rate vs. Time In The Breton Sound Basin. See Appendix 4.

Land Change Dynamics

The Breton Sound Basin is located in the southeast of Louisiana's coastal zone, east of New Orleans. It contains vast expanses of coastal marshes spanning from saline to freshwater environments. Major waterbodies include Breton Sound, the Mississippi River, Bayou Terre aux Boeufs, and Lake Lery. The southern portion of the basin is directly connected to the Gulf of Mexico.

The Breton Sound Basin experienced a net decrease of 105,267 acres (426.0 km^2) in wetland area from 1932 to 2016. In the basin, loss rates have increased since the late 1970s, but in recent years the rate of land loss has decreased. The major causes of land loss in this basin are sediment deprivation, saltwater intrusion, and shoreline erosion.

Hurricane Katrina, 2005, was a major source of land loss in the basin. However, excluding those hurricane effects, CWPPRA marsh creation and terracing projects have contributed to an estimated net land area benefit of approximately 380 acres (1.5 km^2) either from new land built or land sustained, from project inception through 2018.

$35.3 Million Expended

2 Projects Constructed

2 Projects in Engineering & Design

1 Projects in Construction

Figures current as of 2018

Delta Management at Fort St. Philip (BS-11)

Constructed: December 2006

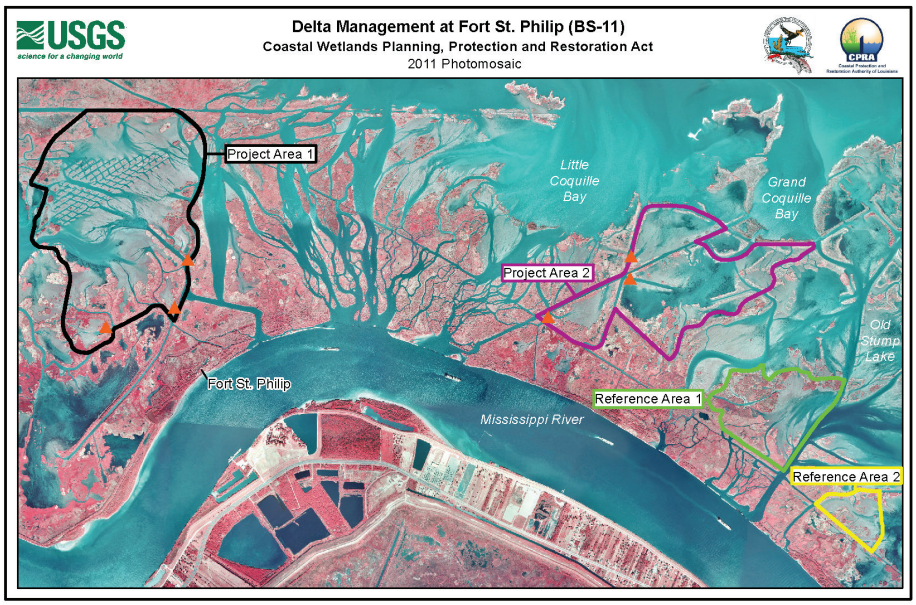


Fig. R. BS-11 project features and reference areas.

The BS-11 project is located on the eastern bank of the Mississippi River at River Mile 19.5 near the historical site of Fort St. Philip. Subsidence, storms, sediment deprivation, and shoreline erosion are all causes of marsh loss in the project area. A study of historic loss within the mapping unit containing the BS-11 project revealed that land acreage showed a net decrease by 58% from 1956 to 2008 (Suir et al. 2014). The 1998 to 2008 period, which included BS-11 construction, was the only period of analysis that experienced net land gains (18%).The project objective is to enhance natural marsh-building processes by utilizing crevasses and earthen terraces. Six crevasses were dredged to promote freshwater and sediment input from the Mississippi River. In addition, 98 earthen terraces (19,600 linear feet) were constructed in a large open water area to create habitat and promote sediment accretion within a crevasse receiving area (Figure B).

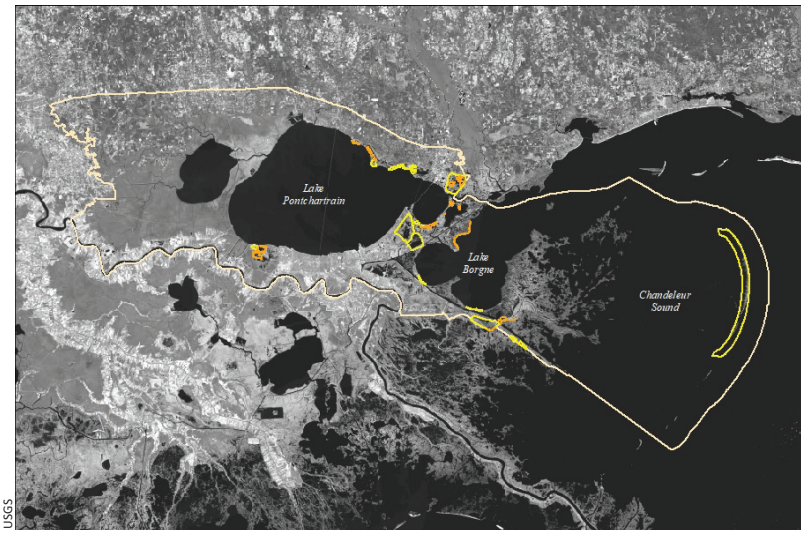
The last evaluation of project performance was in 2012 (Hymel and Breaux 2012). Five years after construction, the project appeared to be capturing sediment and building land, although initial land gain was less than originally anticipated. As typically seen with crevasse projects, much of the sedimentation was subaqueous in years 1 to 5 within the open water receiving areas and sediment elevation was approaching subaerial levels by year 5. From 2002 to 2011, the project area experienced a net gain of 90 acres. The majority of land gain was due to terrace construction and spoil deposits built with dredged material from crevasse construction. Although the reference areas experienced greater land gain, reference Area 1 receives significant sediment input via a canal directly connected to the Mississippi River.

PONTCHARTRAIN BASIN

Land Change Dynamics

The Pontchartrain Basin is an abandoned delta bordered by the Pleistocene Terrace on the north and west, Mississippi River on the south and the Chandeleur Islands on the east. Three major lakes, Maurepas, Pontchartrain, and Borgne cover approximately 55% of the basin and are separated by associated land bridges. Pontchartrain Basin has substantial areas of forested wetlands surrounding Lake Maurepas and a gradient of fresh, intermediate, brackish, and saline marshes from west to east towards the Gulf of Mexico.

The basin includes portions of nine parishes: Ascension, St. James, St. John the Baptist, St. Charles, Jefferson, Orleans, St. Bernard, St. Tammany, and Livingston. The city of New Orleans is located within the basin adjacent to the southern shore of Lake Pontchartrain.



USGS

Fig. S. CWPPRA Projects in the Pontchartrain Basin. See Appendix 4.

The Pontchartrain Basin has experienced approximately 116,634 acres (472.0 km^2) of net wetland loss since 1932 (Couvillion et al. 2017). The rate of land change in the Pontchartrain Basin did not change significantly from 1932 to 2016. Wetland loss in this basin is attributed to limited riverine input, erosion, and deteriorating land bridges on the east and west sides of Lake Pontchartrain. Restoration activities in the Pontchartrain Basin include marsh creation, shoreline protection, hydrologic restoration and barrier island restoration. Excluding hydrologic restoration projects, CWPPRA projects in the Pontchartrain Basin have contributed approximately 1,125 acres (4.6 km^2) of net land area benefit to the landscape collectively via new land built or land sustained from project inception through 2018.

$67.9 Million Expended	7 Projects in Engineering & Design
1 Project in Construction	10 Projects Constructed

Figures current as of 2018


FWS

Fig. T. Goose Point/Point Platte vegetated growth within one of the fill cells, September 2009.

Goose Point/Point Platte Marsh Creation (PO-33) Project

Constructed: February 2009

The PO-33 project extends along the northern shoreline of Lake Pontchartrain on the Big Branch Marsh National Wildlife Refuge. Marsh loss has been attributed to interior ponding, saltwater intrusion, and shoreline erosion. Project objectives are to replace eroded marsh, nourish existing marsh, and prevent breaching of the lake rim shoreline. To accomplish those objectives, sediment was hydraulically dredged in Lake Pontchartrain and pumped into five cells to create 417 acres of marsh. In addition to creating marsh within the fill cells, approximately 195 acres outside the fill cells benefited from marsh nourishment.

Based on a 2014 elevation survey, the marsh creation cells averaged 1.34 feet high which slightly exceeds the pre-construction target of 1.08 feet and exceeds elevations at three CRMS sites in the project vicinity (Gossman and Prendergast 2014). Within the marsh creation cells, the 2012 land-water analysis indicates 359 acres of land and 67 acres of water. Although the project goal of 417 acres of marsh creation was not met within the fill cells, marsh created outside of the fill cells and continued vegetative growth within the fill cells should result in achievement of project goals.

COASTWIDE/DEMONSTRATION

COASTWIDE

Coastwide Vegetative Plantings (LA-39)

Approved: 2011

As part of the CWPPRA process, proven technologies in coastal restoration can be applied as projects across the entire coast. The benefits of marsh plantings in restoration have long been recognized and hurricane events have exposed a need to have a mechanism in place where large-scale planting efforts can be deployed in a timely manner to specifically targeted areas of need, anywhere along the coast. This is a goal of LA-39 Coastwide Vegetative Plantings.

The LA-39 project has facilitated a consistent and responsive planting effort in coastal Louisiana that is flexible enough to routinely plant on a large scale and be able to rapidly respond to critical areas of need following storms or other damaging events. The LA-39 project provides an annual mechanism for nominating, screening, and selecting restoration planting sites; a site can be selected, planned, contracted, and planted within 1-2 years.

Through six years, the project has installed over 450,000 plants among 22 sites. Almost half of those plants were California bulrush, which has good survivability across a variety of water depths and soil conditions. For example, the Prairie planting site, located in the Manchac Wildlife Management Area in St. John the Baptist Parish, received about 13,000 California bulrush plants in March 2014 and has experienced nearly 100% survival; the pictured plantings have expanded to cover about 90% of the area which was all open water prior to planting.

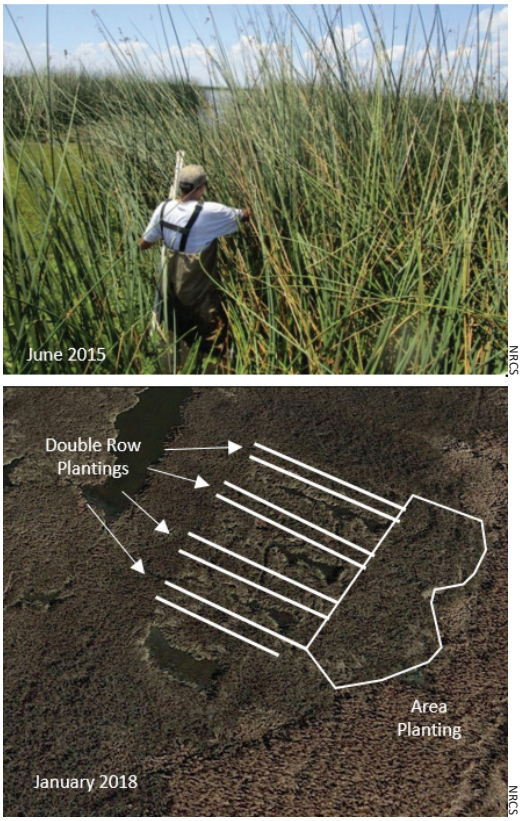


Fig. U. June 2015 and January 2018 LA-39 Prairie planting site.

DEMONSTRATION

Enhancement of Barrier Island Vegetation Demonstration (TE-53)

Approved: 2006

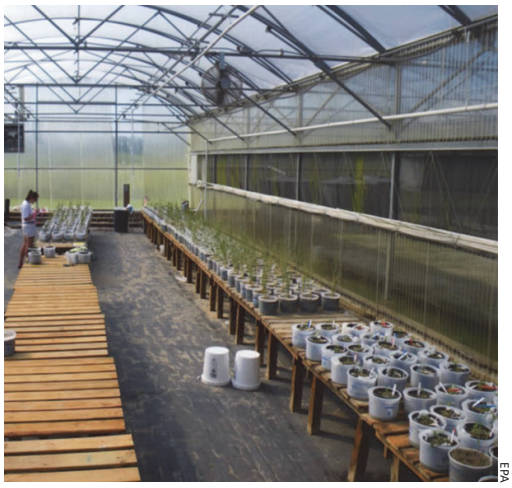


Figure V. Greenhouse study.

Figure W. Different treatment areas.

The CWPPRA Program encourages the use of new technology in coastal restoration across the coast. The Enhancement of Barrier Island Vegetation Demonstration (TE-53) project yielded several clear and important findings relevant to barrier island restoration. Restoring Louisiana's offshore barrier islands is more than dredging and placing sand. The islands provide critical habitat and are the first line of defense to not only day-to-day coastal erosion but also to the destructive forces of major storm events. These critical habitats need vegetation, and planting native plants is a major part of restoration projects. The purpose of the TE-53 demonstration project was to test several technologies and products to enhance the cost-effective establishment and growth of key barrier island and salt marsh vegetation. In addition to a greenhouse study, project components included a field investigation of planting density, fertilizer regime, and humic acid amendment in dune and swale environments. The project underscored the importance of incorporating flexibility in barrier island planting schedules to optimize initial survival and subsequent growth enhancing amendments that may increase plant vigor and expansion.

CWPPRA Benefits to Fish and Wildlife

Benefits Analyses developed by the CWPPRA Environmental Work Group estimate that 90,664 acres of protected and created coastal wetlands can be attributed to CWPPRA in its first 28 years. Those restored swamps, marshes, and barrier islands/headlands and associated open-water habitats provide foraging, nesting, breeding, wintering, refuge, and nursery habitat for a myriad of coastal fish and wildlife. This includes threatened and endangered, at-risk, and rare species, as well as commercially and recreationally valuable species, and State and national fish and wildlife trust resources.

Habitats restored through CWPPRA have aided in the delisting of our national symbol, the bald eagle, and the Louisiana State bird, the brown pelican, from the endangered species list. Located along the Mississippi and Central Flyways, coastal Louisiana provides wintering habitat for more than 5 million waterfowl and habitat for Neotropical migrant birds. Appendix 2 lists some of the threatened, and endangered, and at-risk/rare species found in the Louisiana coastal zone. The appendix also contains the waterfowl, mammals, reptiles, amphibians, and commercially and recreationally important fisheries benefited by CWPPRA projects.

Many economically important saltwater fishes and crustaceans spawn in nearshore and offshore waters of the Gulf of Mexico (e.g., blue crab, red drum, Gulf menhaden, Atlantic croaker, shrimp, and spotted seatrout) but postlarvae and juveniles depend on natural and restored estuarine habitats in Louisiana for foraging and nursery areas. The estuarine-dependent postlarval (larval or smaller may be better than "postlarval") and juvenile fisheries species contribute to the estuarine food web and some serve as prey for predators and highly migratory species (such as jacks, tuna, billfishes and sharks).

Louisiana's coastal wetlands also provide habitat for the commercial trapping of the American alligator and furbearers (e.g., muskrat, mink, and otter) and natural areas for tourist activities such as bird watching, boating, swimming, and hiking.

CWPPRA Projects
Benefit Fish and Wildlife Habitat

25,900 acres
fresh marsh/swamp

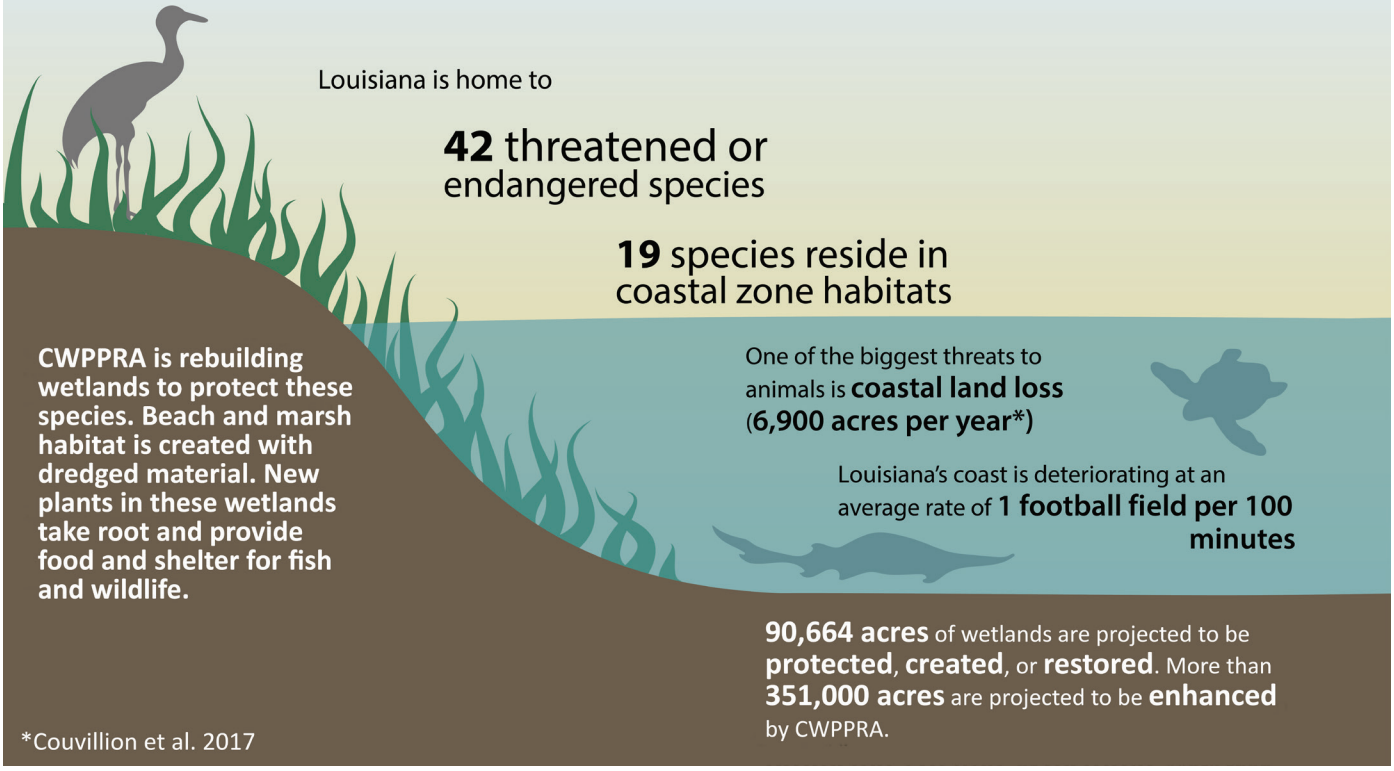
22,400 acres
intermediate marsh

20,500 acres
brackish/saline marsh

6,400 acres
barrier islands/headlands

15,300 acres
coastwide projects

Saving Wetlands Helps Threatened and Endangered Species



CWPPRA Supports Coastal Resiliency

Our national economy benefits greatly from Louisiana's coastal wetlands. Economic activity in Louisiana's coastal zone includes oil and gas production, shipping commerce, commercial fisheries, oyster production, and fur harvesting. This activity accounts for more than 450,000 jobs and billions of dollars in revenues (CPRA, 2011; Batker and others, 2012). Due to wetland loss, however, coastal Louisiana and the economic activity it produces is vulnerable to storm impacts, subsidence, and sea level rise. The CWPPRA Program supports coastal and economic resiliency by identifying coastal areas with increasing land loss rates and executing land building projects in those areas.

"Louisiana's historic and strategic location at the mouth of the Mississippi River, coupled with the Gulf Intracoastal Waterway and extensive pipeline infrastructure, make it the #1 export state in the nation. The working coast annually sends more than $120 billion in goods to the rest of the United States and exports $36.2 billion internationally. The coast also supports infrastructure that supplies 23% of the nation's waterborne commerce and 29% (by weight) of the continental U.S. commercial fisheries landings."

Louisiana Coastal Protection and Restoration Authority
2017 Coastal Master Plan

EPA

Each year 11,000 vessels use the lower Mississippi River with 500 million tons of cargo transported to countries around the world. 60% of the U.S. grain supply is shipped via the lower Mississippi River.

Weeks Marine, Inc.

Restoration projects help protect Port Fourchon on the Louisiana coast. This multi-use coastal port functions primarily as a land base for multiple offshore oil & gas support service companies. A ninety day closure of the port would result in a $7.8 billion gross domestic product reduction nationwide.

CWPPRA

The Gulf Intracoastal Waterway (GIWW) is vital to Louisiana industries that utilize it to reach channels flowing into the Gulf. Projects such as CWPPRA's GIWW Bank Restoration of Critical Areas in Terrebonne (TE-43) stabilized deteriorated channel banks and armored critical lengths with hard shoreline stabilization materials.

Conclusion

The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Program has been actively rebuilding wetlands and helping address coastal land loss for over 28 years. Projects that have rebuilt the barrier islands, improved coastal and interior marshes, and restored natural hydrologic regimes have all left a lasting mark on improving the coastal landscape.

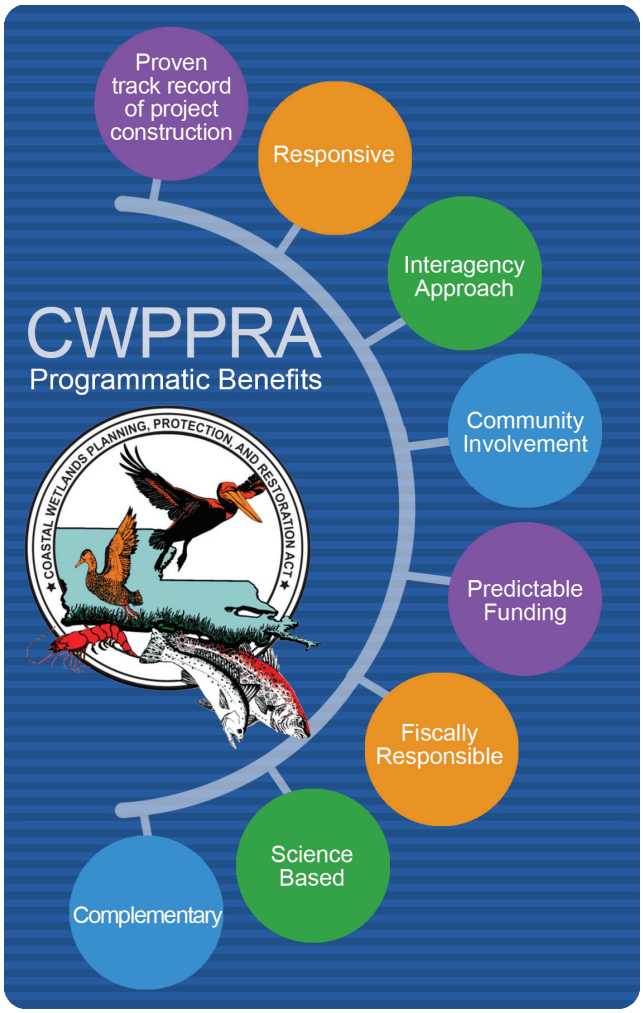
Capitalizing on CWPPRA's public planning process, which includes local government and citizen contribution to project nomination and development, several comprehensive restoration plans have been developed and widely accepted. CWPPRA has laid the foundation on which subsequent restoration initiatives have been modeled. In fact, several projects that have been designed through CWPPRA have been adopted and constructed through these other programs and initiatives. This type of synergy between funding vehicles supports efficiencies in project implementation.

A diverse, interdisciplinary team of academics, scientists, and engineers collects and analyzes data from CWPPRA projects using the Coastwide Reference Monitoring System (CRMS) and project-specific monitoring to evaluate the ecological response from within the project footprint to the entire ecosystem. This helps guide the program to develop projects with a science-driven process. The program supports successful restoration while monitoring the success of projects, to produce low cost restoration techniques for realistic future application.

CWPPRA's funding source, the Sport Fish Restoration and Boating Safety Trust Fund, authorized through October 2020 by the Fixing America's Surface Transportation (FAST) Act of 2015, is supported by excise taxes on fishing equipment, and small engine and motorboat fuel taxes. The Fund contributes 18.673 percent of its annual revenues to CWPPRA appropriations, 70 percent of which goes to support the Louisiana CWPPRA Program. With predictable funding through the Federal Sport Fish and Boating Safety Trust Fund and with CWPPRA's experienced interagency team of coastal scientists and engineers, CWPPRA is, and will continue to be, uniquely able to quickly construct cost-effective priority projects, typically within 3 to 5 years.

With a project selection process that funnels new projects into the planning, engineering and design, and construction phases every year, the restoration of coastal Louisiana through the CWPPRA Program is only limited by funding. Shovel-ready projects are always in the queue and additional funding could be executed quickly to advance project implementation.

Overall, CWPPRA is meeting an otherwise unfilled niche by building near-term projects in acute, and often highly strategic, areas of need. This continues to be CWPPRA's greatest asset and contribution to turning the tide on Louisiana's land loss.



EPA

CWPPRA coastal restoration projects make use of dredged sediments to build new land. Sediment is delivered via pipeline and then placed within project areas to restore lost wetlands, ridges, marshes or barrier islands.

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Fig. F: CPRA LFO, 2005 Aerial CIR, 4-25-2012, Map ID 2012-LFO-004.

Fig G: CPRA LFO, 2008 Aerial CIR, 4-25-2012, Map ID 2012-LFO-005.

Fig I: CPRA, Operations Division, 2005 DOQQ, 11-16-2009, Map ID 2009-TFO-067.

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CWPPRA

CWPPRA shoreline protection and restoration projects are engineered to stabilize coastline erosion while protecting surrounding at-risk inland areas.

Appendices

Appendix 1. Useful Links

http://www.lacoast.gov/ne/Projects/List.aspx
Complete list of authorized projects under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) since its implementation in 1990.

https://www.lacoast.gov/crms2/Home.aspx
Monitoring data at 390 Coastwide Reference Monitoring System (CRMS) sites

http://www.mvn.usace.army.mil/Missions/Environmental/CWPPRA/Meeting-Documents/
CWPPRA Public Meeting Documents

http://www.mvn.usace.army.mil/Missions/Environmental/CWPPRA/Priority-Project-Lists/
CWPPRA Priority Project List Documents and Process

https://www.lacoast.gov/calendar/
CWPPRA Meeting Calendar

http://coastal.la.gov/our-plan/2017-coastal-master-plan/
2017 Coastal Master Plan

Task Force Member Agencies:

https://www.fws.gov/southeast/lafayette; http://www.fws.gov/coastal/CoastalGrants/
U.S Department of the Interior (represented by the U.S. Fish and Wildlife Service)

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/la/programs/easements/acep/?cid=nrcs14p2_015685
U.S. Department of Agriculture (represented by the Natural Resources Conservation Service)

http://habitat.noaa.gov/restoration/index.html
U.S. Department of Commerce (represented by the National Oceanic and Atmospheric Administration National Marine Fisheries Service)

http://www.epa.gov/region06/6wq/at/cwppra.htm
U.S. Environmental Protection Agency (represented by the Water Division of EPA Region 6)

http://www.coastal.la.gov/
Louisiana's Governor's Office (represented by the Coastal Protection and Restoration Chairman)

http://www.mvn.usace.army.mil/Missions/Environmental/CWPPRA
U.S. Army Corps of Engineers (represented by the New Orleans District)

Appendix 2. Threatened, Endangered, and Rare Species, Migratory Birds, Mammals, Amphibians, and Important Fisheries of the Louisiana Coastal Zone

Table 1. Threatened, endangered, and rare species of the Louisiana coastal zone.

Coastal Habitat	Threatened/endangered species	Rare Species
Barrier Islands/Barrier headlands	Piping plover, red knot, Kemp's Ridley sea turtle, loggerhead sea turtle.	snowy plover, Wilson's plover, reddish egret, & gull billed tern, American oystercatcher, Caspian tern, sooty tern, and brown pelican. Black skimmer, long-billed curlew, Hudsonian godwit, western sandpiper, stilt sandpiper, buff breasted sandpiper, and short billed dowitcher.
Brackish or saline marshes	Saltmarsh topminnow.	Diamondback terrapin, seaside sparrow.
Fresh-intermediate marshes/swamps		Bald eagle, wood stork, little blue heron, mottled duck.
Coastal marshes	Black rail (petitioned for listing).	Peregrine falcon, sand hill crane, glossy ibis.
Coastal bays/rivers	West Indian manatee, Atlantic sturgeon (Lake Pontchartrain - Breton Sound).	Osprey, American swallow-tailed kite.

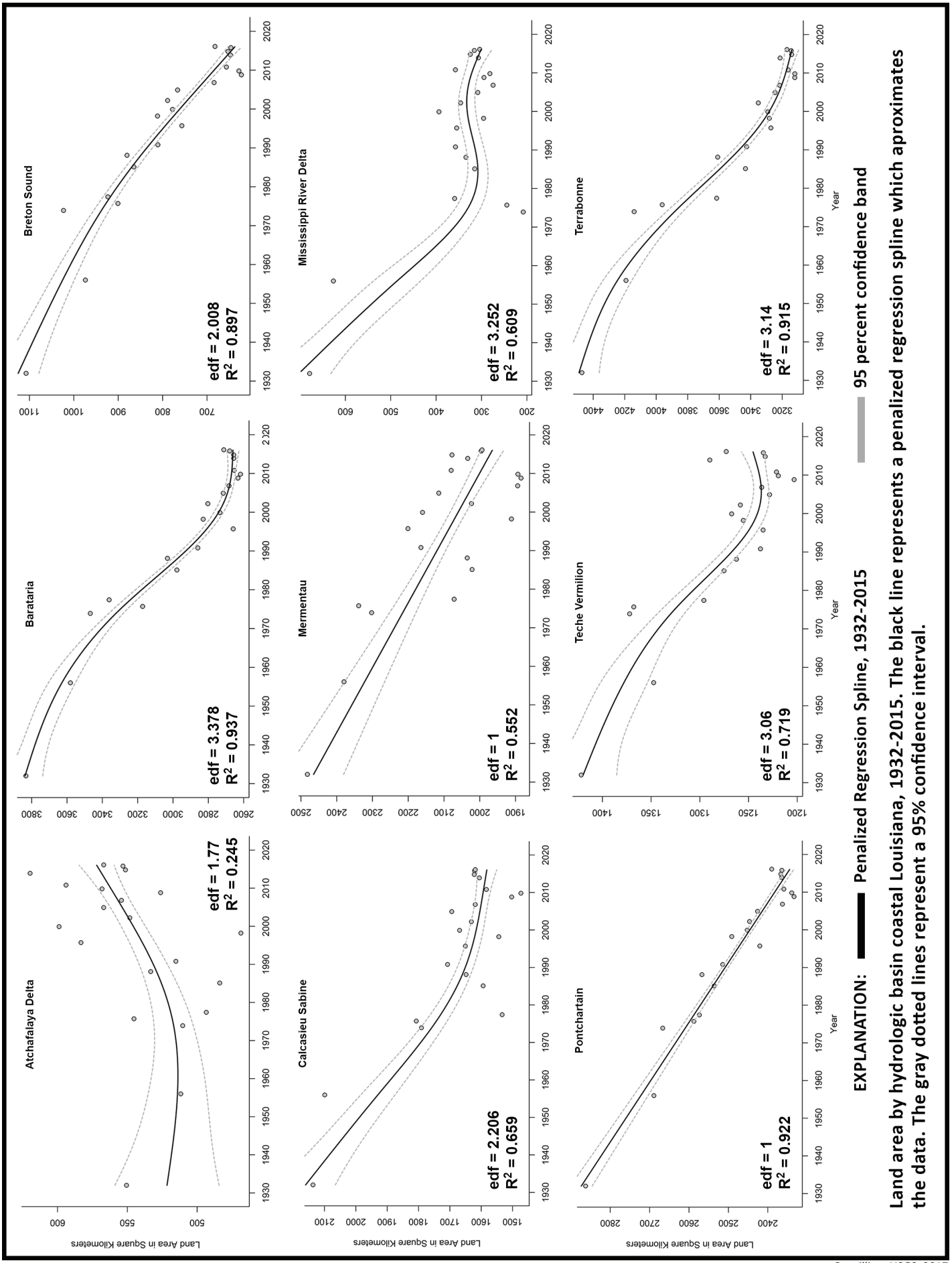
Table 2. Louisiana waterfowl, other migratory and resident birds, and mammals, reptiles, and amphibians benefited by CWPPRA projects.

Dabbling ducks	Diving ducks	Geese	Other migratory and resident birds	Mammals, reptiles, and amphibians
Mallard, mottled duck, gadwall, American widgeon, pintail, northern shoveler, green-winged teal, and blue-winged teal.	Lesser scaup, ring-necked duck, and several merganser species.	White-fronted geese, Canada geese, and snow geese	Brown and white pelicans cormorants and anhingas. Herons: great blue heron,little blue heron, bitterns, green-backed heron, yellow-crowned night heron, black-crowned night heron, great egret, snowy egret, glossy ibis, white-faced ibis, and white ibis. Others: American coots, rails, gallinules, shorebirds, terns, boat-tailed grackle, red-winged blackbird, eastern kingbird, northern harrier, belted kingfisher, and songbirds.	Mammals: Louisiana black bear, nutria, muskrat, mink, river otter, raccoon, swamp rabbit, coyote, and white-tailed deer Reptiles: American alligator, western cottonmouth, red-eared turtle, common snapping turtle, and soft-shell turtle Amphibians: tree frogs, bullfrog, pig frog, leopard frogs, and salamanders

Table 3. Commercially and recreationally important fisheries species benefited by CWPPRA projects.

Freshwater fisheries	Commercially important fisheries	Recreationally important estuarine species
Largemouth bass, crappie, bluegill, gar, blue catfish, and shad. Crawfish and river and grass shrimp	Gulf menhaden, striped mullet, catfishes, gars, and freshwater drum. Brown and white shrimp, blue crab, Gulf stone crab, and the American oyster	Spotted sea trout, white trout, red drum, black drum, Atlantic croaker, spot, southern flounder, snappers, mackerel, groupers, and sharks.

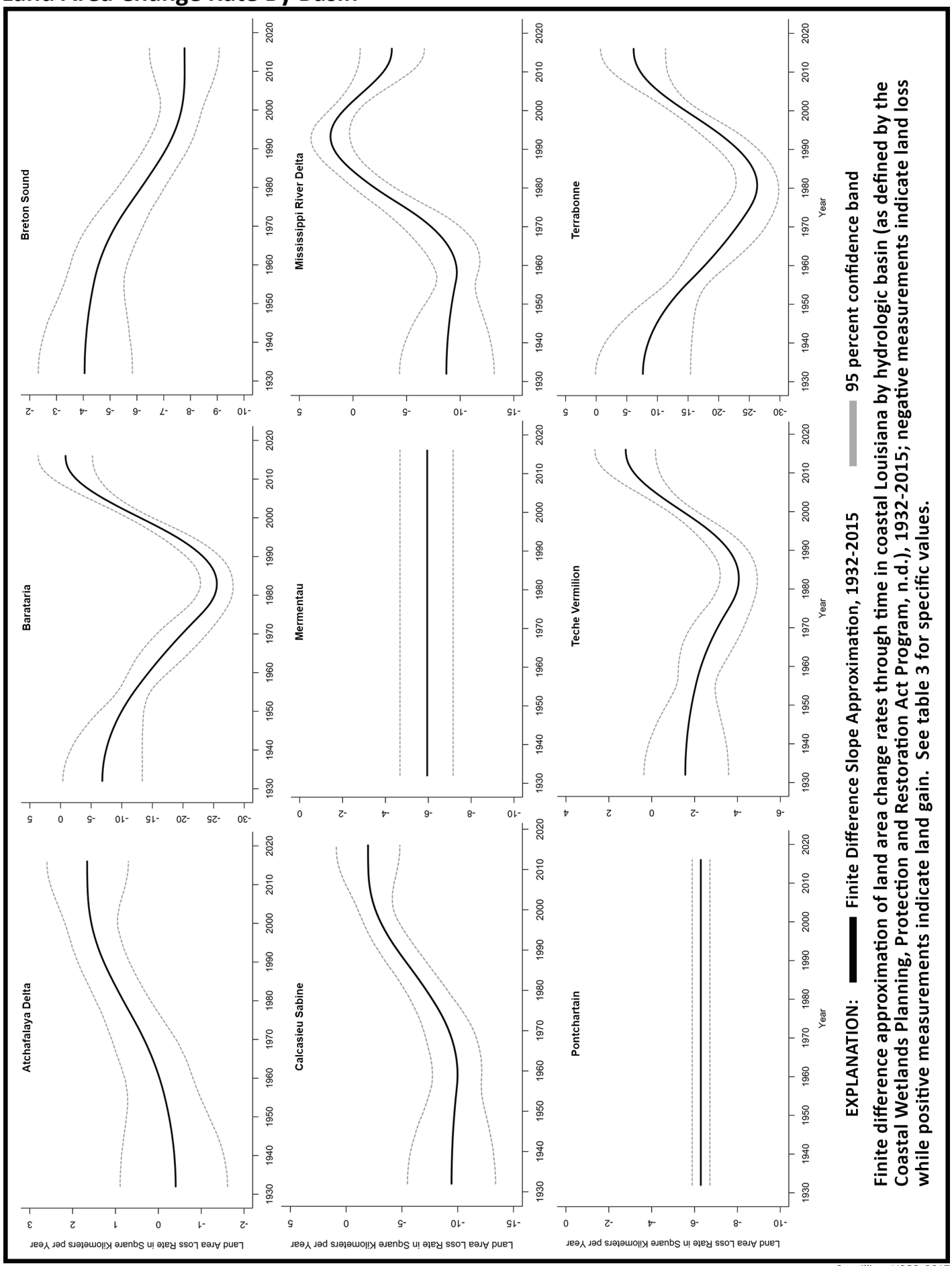
Appendix 3. Land Area By Basin



Land area by hydrologic basin coastal Louisiana, 1932-2015. The black line represents a penalized regression spline which aproximates the data. The gray dotted lines represent a 95% confidence interval.

Couvillion, USGS. 2017

Land Area Change Rate By Basin

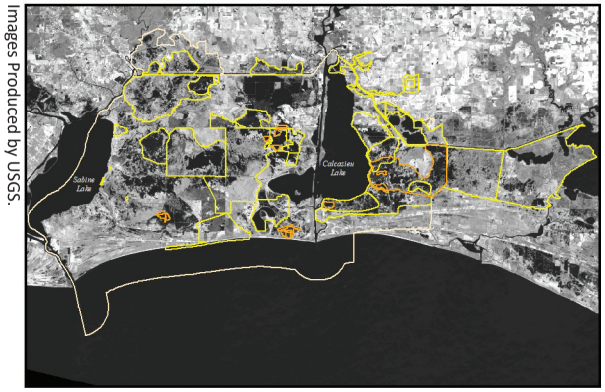


Finite difference approximation of land area change rates through time in coastal Louisiana by hydrologic basin (as defined by the Coastal Wetlands Planning, Protection and Restoration Act Program, n.d.), 1932-2015; negative measurements indicate land loss while positive measurements indicate land gain. See table 3 for specific values.

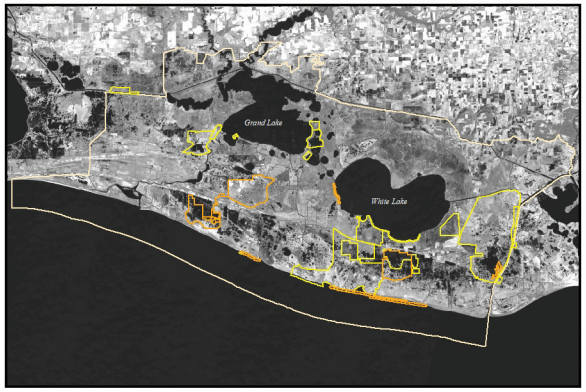
Couvillion, USGS. 2017

Appendix 4.

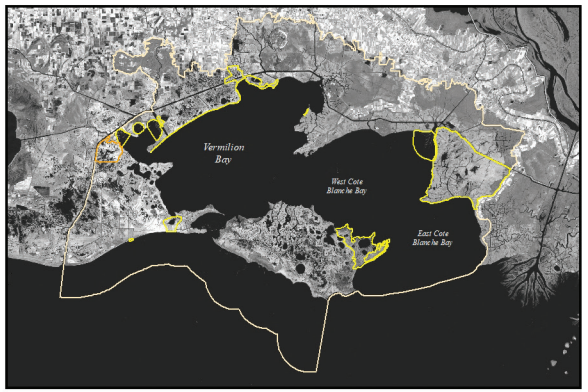
Images Produced by USGS.



Calcasieu-Sabine Basin has a total of
27 active CWPRA projects.

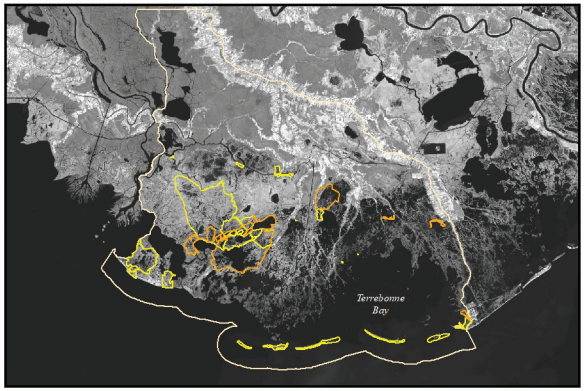


Mermentau Basin has a total of
14 active CWPPRA projects.

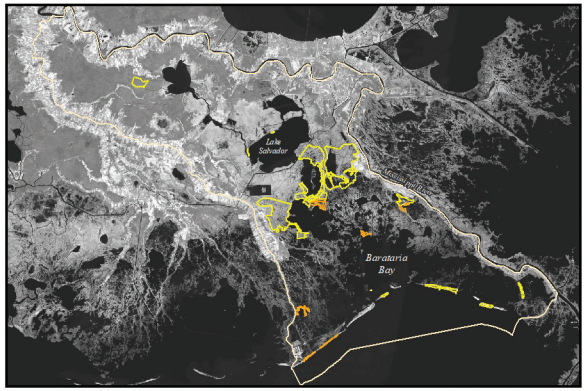


Teche-Vermillion Basin has a total of
12 active CWPRA projects.

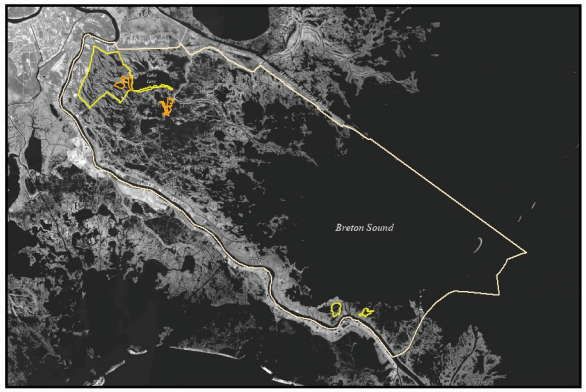
Atchafalaya Basin has a total of
3 active CWPRA projects.



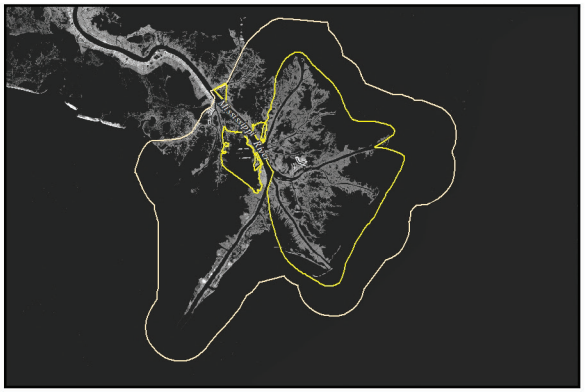
Terrebonne Basin has a total of
29 active CWPRA projects.



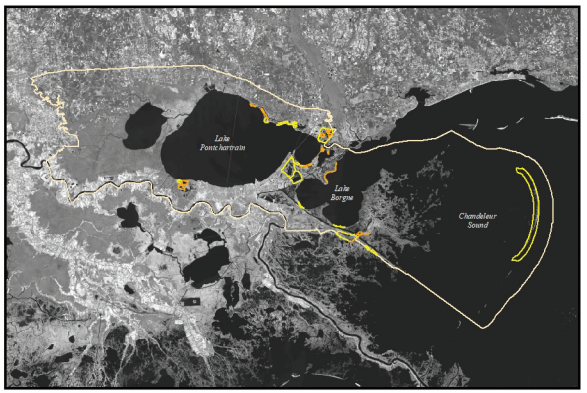
Barataria Basin has a total of
31 active CWPRA projects.



Breton Sound Basin has a total of
5 active CWPRA projects.



Mississippi River Delta Basin has a total of
4 active CWPRA projects.



Pontchartrain Basin has a total of
18 active CWPRA projects.

The 2018 Evaluation Report to the U.S. Congress on the Effectiveness of Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Projects